

Lepus callotis. By Troy L. Best and Travis Hill Henry

Published 23 April 1993 by The American Society of Mammalogists

Lepus callotis Wagler, 1830

White-sided Jackrabbit

Lepus callotis Wagler, 1830:23. Type locality "Mexico" (southern end of Mexican tableland—Nelson, 1909:122).

Lepus mexicanus Lichtenstein, 1830:101. Type locality "Mexico" (southern end of Mexican tableland—Nelson, 1909:122).

Lepus nigricaudatus Bennett, 1833:41. Type locality "that part of California which adjoins to Mexico" (probably southwestern part of Mexican tableland; Nelson, 1909:122).

Lepus gaillardi Mearns, 1895:560. Type locality "west fork of the Playas Valley near monument No. 63, Mexican boundary line." An historical account and explanations for the confusion as to whether the type specimen was collected in the United States or in Mexico are presented by Bogan and Jones (1975).

CONTEXT AND CONTENT. Order Lagomorpha, Family Leporidae, Subfamily Leporinae, Genus *Lepus*, Subgenus *Macrotolagus*. There are ca. 19 species in the genus *Lepus* (Honacki et al., 1982). Two subspecies of *L. callotis* are recognized (Hall, 1981):

L. c. callotis Wagler, 1830:23, see above (*mexicanus* Lichtenstein and *nigricaudatus* Bennett are synonyms).

L. c. gaillardi Mearns, 1895:560, see above (*battyi* J. A. Allen is a synonym).

DIAGNOSIS. *Lepus callotis* (Fig. 1; ca. 2.5–2.7 kg—Anderson, 1972; Davis and Lukens, 1958; Dunn et al., 1982) can be distinguished from *L. alleni* (ca. 2.7–5.9 kg—Vorhies and Taylor, 1933) by its smaller size (Mearns, 1895), shorter ears (length of ear is 102–136 mm—Anderson and Gaunt, 1962, rather than 138–173 mm as in *L. alleni*—Vorhies and Taylor, 1933), and whitish sides of the body rather than grayish sides (Hoffmeister, 1986). From *L. callotis*, *L. flavigularis* is distinguished by its large size, its yellowish throat and ears, and coloration of the nape, which has a brownish longitudinal band bordered laterally by black spots that are covered by the ears when they are laid back (Anderson and Gaunt, 1962; Hall, 1981).

From *L. californicus*, *L. callotis* can be distinguished by its whitish rather than brownish-gray sides, and white-tipped rather than black-tipped ears (Hoffmeister, 1986). The pelage of *L. callotis* is shorter and coarser than that of *L. californicus* (Mearns, 1895). *L. callotis* also is more buffy or fawn colored dorsally, the pale-gray

rump patch blends into the white sides, and the upper surface of the tail is black (Bailey, 1931). Apparently no single cranial measurement, or pair of measurements used as a ratio, allows separation of specimens of *L. callotis* from *L. californicus*, but several qualitative differences exist between crania of these species. Compared with that of *L. californicus*, the skull of *L. callotis* (Fig. 2) has a higher nasal aperture, a smaller and more inclined supraorbital surface, more ventral placement of the posteriormost point of the skull and consequently more inclined parietal, lesser breadth across



FIG. 1. *Lepus callotis* near Cloverdale, Hidalgo Co., New Mexico. Photograph courtesy of C. G. Schmitt and M. C. Conway, New Mexico Department of Game and Fish.



FIG. 2. Dorsal, ventral, and lateral views of cranium, and lateral view of mandible of *Lepus callotis* (female from Animas Valley, Hidalgo Co., New Mexico, University of New Mexico Museum of Southwestern Biology 36147). Greatest length of cranium is 97.6 mm. Photographs by T. H. Henry.

the auditory bullae, less compact skull in posterior view, more prominent supraorbital ridges in posterior view, smaller auditory meatuses, deeper rostrum, smaller bullae, and less constriction of the basioccipital. In addition, the ears of *L. callotis* (mean of 30 adults from various states is 118.2; range, 102–136 mm) generally are shorter than those of *L. californicus* (mean of 56 adults from Chihuahua is 131.9; range, 120–147 mm—Anderson and Gaunt, 1962).

GENERAL CHARACTERS. Dorsally, the body is pale ochraceous-cinnamon, mixed with black. The underside of the tail is white, its upper surface is black, and many of the hairs are tipped with white. The median black line of the rump is indicated by a mostly concealed line of sooty, brownish, and white-tipped hairs. The sides are pure white, the rump and thighs are white and lined with a few black hairs, and the rump is faintly divided by a median dusky stripe. The limbs are white and stained with buffy on their outer surfaces. The gular pouch is buffy, becoming more ochraceous on the front of the shoulders and sides of the neck. The head is cream buff, mixed with black, and has a whitish area on the side around the eye. The underparts are white, with a trace of the colored patches usually present in front of the thighs. The ears are scantily coated with short hairs and their concave surfaces are almost bare, with a dusky spot along the posterior border. The convex surfaces of the ears are yellowish brown, mixed with black anteriorly, white posteriorly, and at the apex. The long fringes of the anterior edge of the ear are ochraceous buff, except subapically where there is a tuft of black. The fringes of the tip of the ear and the posterior edge are white. The nape is ochraceous buff (Mearns, 1895).

For *L. c. callotis* in fresh winter pelage, the top and sides of the head and back are dark pinkish-buff, heavily overlaid with black. The nape is black and sometimes is grizzled on the surface with gray. The front one-half of the ears is dark buff or grayish buff. The posterior one-half of the ears is black on the basal one-third, and white on the terminal two-thirds, with no trace of black at the tip. The front borders of the ears are fringed with buff or ochraceous-buff hairs, and the posterior border and entire tip are velvety white. Inside the ears is a well-marked dusky line on the membrane along the posterior border, broadening to form a broad blackish patch underlying the buffy hairs at the tip. The rump, back, and outside of the hind legs are iron gray, and the front of the hind legs and tops of the feet are white. The median line of black on the rump is not strongly marked and not extending much above the base of the tail. The entire top, sides, and tip of the tail are black. The basal two-thirds of the underside of the tail is white and the terminal one-third is black. The front of the forelegs and tops of the forefeet vary from pale gray to dull iron-gray, but are palest on the feet. The underside of the neck is dull dark-grayish buff, varying to buffy drab. The remaining underparts, including the flanks, are white. On the flanks, white extends high on the sides and abruptly ends posteriorly against the iron gray of the rump patch. A few scattered long black hairs occur throughout the white of the underparts and flanks. In worn pelage, most of the heavy black wash on the upperparts is lost, and the upperparts bleach to a pale buff-pinkish or buff-yellowish (Nelson, 1909).

For *L. c. gaillardi* in worn pelage, the top and sides of the head and back are deep dull vinaceous-buff approaching fawn color. The nape is the same, but duller. The front one-half of the ears is dull buff, and the posterior one-half is white, without a trace of black at the tip. The inside of the ears is buff, becoming ochraceous buff on the fringe along the front border and buffy white on the posterior edge. There is a narrow dusky line on the membrane inside of the ear, along the posterior border, widening to form a broad black patch 2.5 cm wide underlying the short buffy hairs at the tip. The outside of the rump and back of the hind legs are pale iron-gray, sometimes becoming whitish from loss of black hairs. The rump is divided by a median line of dusky extending down and becoming black over the upper surface of the tail. The underside of the tail is white to the tip. The front of the hind legs and tops of the feet are white. The front of the forelegs and tops of the feet are gray; palest on the feet. The underside of the head is dull buff becoming whitish in the middle, and the underside of the neck is dark dull-buff. The rest of the underparts, including the flanks, are white (Nelson, 1909).

Average and range of measurements (in mm) for *L. c. callotis* and *L. c. gaillardi*, respectively, are: total length, 550 (493–586), 542 (432–598); length of tail, 70 (47–90), 72 (51–92); length of hind foot, 131 (118–141), 130 (121–139); length of ear from

notch, 126 (108–149), 120 (109–133); basilar length of cranium, 71.6 (64.3–76.8), 71.5 (67.3–75.0); breadth of braincase, 29.9 (28.4–32.9), 29.8 (28.5–31.5); breadth of bullae, 30.7 (29.1–33.4), 30.5 (28.2–33.8); basioccipital constriction, 7.9 (6.6–9.3), 8.3 (6.7–9.8); frontal depression, 3.0 (2.0–4.4), 3.8 (2.5–5.5—Anderson and Gaunt, 1962). Additional measurements (in mm) for *L. c. gaillardi* from Chihuahua are: zygomatic breadth, 43.1 (40.1–44.8); postorbital constriction, 12.6 (11.8–13.9); length of maxillary tooththrow, 16.5 (15.4–17.3); length of incisive foramen, 22.1 (21.0–24.9); breadth of mesopterygoid fossa, 8.7 (7.8–10.1); palatal length, 6.5 (5.0–7.2—Anderson, 1972). Averages of other measurements of *L. callotis* (in mm) are: basilar length, 71.9; zygomatic breadth, 43.8; postorbital constriction, 12.4; length of nasals, 39.0; width of nasals, 19.4; length of maxillary tooththrow, 17.1; diameter of external auditory meatus, 5.1; breadth of braincase, 25.3; length of palatal bridge, 6.5; depth of rostrum, 20.8; parietal breadth, 23.9; length of bulla, 13.6 (Dixon et al., 1983); length of claws, 10.0; spread of ears from tip to tip, directed laterally, males 332 (321–349), females 345 (326–365); occipitonasal length of cranium, males 90 (85–93), females 91 (89–93—Allen, 1906). Average weight of four adults in New Mexico was 2.7 kg (Dunn et al., 1982), one from Chihuahua weighed 2.54 kg (Anderson, 1972), and in Guerrero, the average weight of adults was ca. 2.5 kg (Davis and Lukens, 1958).

Some sexual dimorphism is present. Measurements of white-sided jackrabbits in New Mexico indicate that females are larger than males: mass, 1.82 kg (range, 1.50–2.20), 2.95 (2.45–3.20); total length, 529 mm (range, 525–532), 558 (541–575); length of hind foot, 121 mm (119–124), 126 (121–135); length of ear, 135 mm (111–155), 143 (122–155) for males and females, respectively (J. C. Bednarz, in litt.).

Geographic variation exists in most morphologic traits. Skulls from northwestern Chihuahua differ most conspicuously from skulls from Jalisco in having larger and more elevated supraorbital processes and therefore a greater frontal depression, and in having a greater breadth at the basioccipital constriction (Anderson and Gaunt, 1962). Compared with *L. c. callotis* from Jalisco, *L. c. gaillardi* from Chihuahua have paler and buffier pelage, including the fringe of hair along the inner margin of the ear, the circumorbital ring, the throat patch, and the hue of the subterminal band on dorsal cover hairs. White-sided jackrabbits from Chihuahua also have paler rump patches that contrast less with the whitish flanks, and paler patches on the shoulders that tend to contrast with the darker middorsal pelage (Anderson and Gaunt, 1962). Within Chihuahua, animals in westcentral parts of that state differed significantly in zygomatic breadth and length of maxillary tooththrow from those in northwestern Chihuahua (Anderson, 1972). In summary, *L. c. callotis* has a blackish hue, a black nape patch, and moderate supraorbital processes (moderate frontal depression), whereas *L. c. gaillardi* has a pale-buff hue, brown rather than black nape, and large supraorbital processes (consequently greater frontal depression—Anderson and Gaunt, 1962).

DISTRIBUTION. The white-sided jackrabbit occurs from southern New Mexico to northern Oaxaca (Fig. 3; Hall, 1981). In Mexico, its distribution corresponds to the Chihuahua–Coahuila (Goldman, 1951) and Chihuahua–Zacatecas biotic regions (Goldman and Moore, 1946). The range in the United States is restricted to an area of ca. 120 km² in southern Hidalgo Co., New Mexico (Bednarz and Cook, 1984). However, this species also may occur in Arizona (Hoffmeister and Goodpaster, 1954).

Altitudinal range is ca. 1,350–2,100 m in northwestern Chihuahua, 2,550 m in northern Puebla, and ca. 750 m in Morelos. The zonal range includes the upper and lower Sonoran, lower part of the transition, and upper border of the arid tropics (Nelson, 1909). The two subspecies seem to be separated geographically at or near the prominent valley of the eastward-flowing Río Nazas, which also marks the dividing line for subspecies of several other mammals of the open lands of central and eastern Durango (Baker and Greer, 1962; Petersen, 1976; Schmidly, 1977).

FOSSIL RECORD. The genus *Lepus* had its origin in the late Pliocene or early Pleistocene in the Holarctic. The genus spread southward in the later Pleistocene and now extends (excluding introductions) into South Africa (Dawson, 1967).

A specimen from Burnet Cave, 1,380 m, Eddy Co., New Mexico (age, 7,432 ± 300 years before present), tentatively iden-

tified as *L. alleni* (Schultz and Howard, 1935), may be *L. callotis* (Harris, 1977). No other fossils are known. A population of *L. californicus* may have become isolated in Mexico and diverged to *L. callotis*. A population of this divergent stock then became isolated on the western coastal plain where it diverged even further from the *L. californicus* stock to become *L. alleni*. Later, in southern Oaxaca, a second population may have become isolated from the main stock of *L. callotis* and diverged to *L. flavigularis* (Anderson and Gaunt, 1962).

FORM AND FUNCTION. On 17 June, an adult male from near the Mexican boundary had commenced molting. The molt had proceeded backward from the nose to the shoulders, and in the dorsal median line to a point behind the middle of the back. There also were scattered patches on the sides and posterior portion of the back where the winter hair had fallen out and was being replaced. The ventral surface was still covered with dense, long hair. The difference in color between winter and summer coats was slight. An adult female from here on 16 June was similar in coloring, but had acquired the short summer pelage on the entire ventral surface. The change had not progressed as far on the dorsum as on the ventral surface, but shedding had taken place on the head and nape, over a large area of the posterior border of the back, and in the median area of the rump to the tail. On 29 June, another adult female at this locality had shed the winter hair on the chest and anterior portion of the abdomen, on the nose, and a few insignificant spots scattered over the upper surface. Thus, she was in a nearly complete winter pelage. Two females on 16–17 June and another on 15 September, had a patchy mixture of the winter and summer coats on their sides (Mearns, 1895).

A typical dorsal guard hair has a terminal black band, a sub-terminal colored band, then another blackish band, and a basal part that is pale gray or whitish. The colored band and the distal part of the basal gray band have a more orange hue in white-sided jackrabbits from Chihuahua than in those from Jalisco, and the medial blackish band tends to be narrower and paler. This orange (or buff) hue occurs also in the terminal band of guard hairs, which typically are blackish basally and pale distally (Anderson and Gaunt, 1962). The feet have shorter hair than does the body; the claws are entirely exposed (Mearns, 1895).

As in all *Lepus*, the dental formula is $i\ 2/1, c\ 0/0, p\ 3/2, m\ 3/3$, total 28 (Nowak and Paradiso, 1983). The skull (Fig. 2) is high and rather wide. The supraorbital process of the frontal bone is elevated and massive. The nasal bones are long and wide, especially posteriorly. The rostral portion of the skull is of medium length, the braincase of average capacity, and the teeth of usual size for the genus (Mearns, 1895). For *L. c. callotis*, the skull is rather short and stout, and the upper profile is highly arched. Nasals are proportionately shorter and less tapered toward the tip than in *L. c. californicus*, giving the rostrum a heavier appearance when viewed from above. The supraorbital and postorbital processes in *L. c. callotis* are short and broad, raised higher above the plane of the frontals than usual, and divergent posteriorly, with the tip usually free. The jugal is broad and flat with a pit anteriorly. The basioccipital is rather small and strongly constricted posteriorly. For *L. c. gailardi*, the skull has short, broad supraorbital and postorbital processes raised even higher above the plane of the frontals than in *L. c. callotis*, giving a sunken appearance to the frontal area just posterior to the nasals. The rostrum is lighter and more tapered than in *L. c. callotis*. The frontal area is broad and depressed. The basioccipital is small, proportionately long and narrow, and there is only a slight constriction posteriorly; consequently, the sides are nearly straight and parallel (Nelson, 1909).

ONTOGENY AND REPRODUCTION. The minimum length of the breeding season is 18 weeks, extending from mid-April to mid-August (Dunn et al., 1982), but one female was pregnant on 12 March and a juvenile was present on 10 October (Cook, 1986). In New Mexico, a pregnant lactating female had small embryos on 19 July (Bogan and Jones, 1975; Findley et al., 1975). The average number of young per litter, from a sample of 10 females, was 2.2 (Dunn et al., 1982). An adult female from near the Mexican boundary had three small fetuses on 16 June (Mearns, 1895). In Chihuahua, pregnant females occurred in May, June, and July (Anderson, 1972). In Guerrero, no pregnant females were found in June or December, but one was lactating on 27 June (Davis and Lukens,

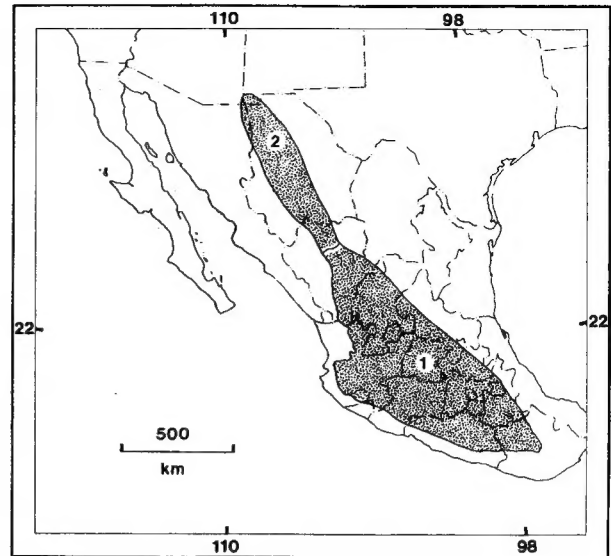


FIG. 3. Distribution of *Lepus callotis* in western North America (Hall, 1981): 1, *L. c. callotis*; 2, *L. c. gailardi*.

1958). In Chihuahua, the number of embryos recorded were 1, 2, 2, 2, and 4 (Anderson, 1972).

In Guerrero, two juveniles were observed in late June (Davis and Lukens, 1958), and in Durango, a young in first pelage was observed 29–30 June (Allen, 1904). On 16–17 June, two young females from near the Mexican boundary were still in the soft, woolly coat of early life, except on the front of the head and anterior portion of the middle of the back, where the coarser coating had recently been acquired. The new pelage was vinaceous buff, and the rest of the upper surface of the body varied from cream buff to cinnamon. The crown of the head was cinnamon; its sides clayey buff, except the orbital stripe, which was cream buff, and the gular area was buff. The upper side of the tail was black, considerably grizzled, and mixed with yellowish white; the central stripe of the rump was faintly indicated (Mearns, 1895).

ECOLOGY. *Lepus callotis* inhabits the grassy plains of southwestern New Mexico near the Mexican border (Fig. 4), southward along the eastern base of the Sierra Madre Occidental through northern Chihuahua, and the open plains of the southern one-half of the Mexican tableland (Nelson, 1909). It avoids hilly areas, instead selecting level topography with little cover of shrubs (Bednarz and Cook, 1984). In New Mexico, it is found in stands of tabosagrass (*Hilaria mutica*—Findley, 1987), and occurs there at elevations of 1,525–1,620 m in an area with an average annual precipitation of 38.3 cm. Here the desert-grassland community is dominated by blue grama (*Bouteloua gracilis*), black grama (*B. eriopoda*), ring muhly (*Muhlenbergia torreyi*), buffalograss (*Buchloe dactyloides*), wolftail (*Lycurus phleoides*), and bottlebrush squirreltail (*Sitanion hystrix*). The more common shrubs and forbs include goldenweed (*Haplopappus*), globe-mallow (*Sphaeralcea*), flatsedge (*Cyperus*), nightshade (*Solanum jamesii*), snakeweed (*Gutierrezia sarothrae*), soap-tree yucca (*Yucca elata*), and honey mesquite (*Prosopis glandulosa*—Bednarz and Cook, 1984).

In New Mexico, the population density of *L. callotis* is greatest in habitats composed of $\geq 65\%$ grasses, $\leq 25\%$ forbs, and $< 1\%$ shrubs (Dunn et al., 1982). In the only intensive study of habitat selection of white-sided jackrabbits, this species was observed in grassland habitat 97.1%, grass-forb association 2.4%, and grass-shrub type 0.5% of the time; all the non-grassland habitat was adjacent to large expanses of grassland habitat (Bednarz and Cook, 1984).

In New Mexico, the diet consists of $> 99\%$ grass. The only nongrass item in significant amounts was sedge nutgrass (*Cyperus rotundus*). Plants consumed were buffalograss, tabosagrass, fiddle-neck (*Amsinckia*), wolftail, blue grama, vine mesquite (*Panicum obtusum*), ring muhly, woolly Indian wheat (*Plantago purshii*), and Wright buckwheat (*Eriogonum wrightii*—Dunn et al., 1982). A



FIG. 4. Habitat occupied by *Lepus callotis* near Cloverdale, Hidalgo Co., New Mexico. Photograph courtesy of C. G. Schmitt and M. C. Conway, New Mexico Department of Game and Fish.

shelter form contained a partially chewed flower of *Cirsium*. The stomach of one white-sided jackrabbit contained finely chewed green plant material (Bogan and Jones, 1975).

Population densities of this species are difficult to measure. Flush transects are not a reliable census method, because of the extremely low density of *L. callotis*. In New Mexico, one observer spent >100 h walking an estimated 130 km and flushed three white-sided jackrabbits. Night lighting provides a more accurate method of observing this species (Bednarz and Cook, 1984).

In New Mexico, average densities are ca. 1/32 ha (Dunn et al., 1982). Density ranged from 8 to 15 white-sided jackrabbits observed along a 63-km census route. A decline in density of *L. callotis* was accompanied by an increase in numbers of *L. californicus* and *Sylvilagus audubonii*. It appears that the numbers of *L. callotis* have decreased as the density and vigor of grass plants declined, while populations of *L. californicus* and *S. audubonii* increased in response to a concurrent increase in forb and shrub cover (Bednarz and Cook, 1984).

Interaction between *L. callotis* and *L. californicus* is low and probably occurs only in areas of marginal habitat (Dunn et al., 1982). White-sided jackrabbits usually occupy large expanses of grassland, in which *L. californicus* is not common. In areas where grassland is interspersed with scattered shrubs and forbs, *L. californicus* is more common than *L. callotis*. Only *L. californicus* is found where shrubs and forbs are the dominant vegetation. Overgrazing and deterioration of grassland vegetation seem to favor the occurrence of *L. californicus* more than *L. callotis* (Conway, 1976; Findley, 1987).

In Durango, the population of *L. callotis* on the elevated grasslands has been diminishing for years. Overgrazing and other ranching practices, which have altered plant growth on grasslands, may have improved the habitat for *L. californicus*, but reduced it for *L. callotis* (Baker and Greer, 1962). *L. callotis* was less commonly observed than *L. californicus*, and when seen, *L. callotis* was in more grassy, less heavily grazed areas. The two species were sympatric at Chorro (Baker, 1960).

In Zacatecas, *L. callotis* formerly lived in open grassland-plains habitat, but now is confined mostly to lightly and moderately grazed upland-grasslands, foothills, and glades in the forested uplands in the southwestern part of the state. Overgrazing and the encroachment of shrubs on open lands may have encouraged the expansion of the range of *L. californicus* and reduced that of *L. callotis* (Matson and Baker, 1986).

In Guerrero, *L. callotis* is common in the more arid interior basins, but not as common as *Sylvilagus cunicularius*. Like *S. cunicularius*, it is associated with cultivated areas and pastures. *L. callotis* was observed in cornfields and the adjacent thorn-brush hillsides in the valley of the Río Huacapa near Colotlipa, in an oak-brush pasture near Almolonga, and in an open, cultivated valley near Omiltemi. These hares appear not to range out of the open basins and valleys onto the more heavily wooded slopes and hilltops (Davis and Lukens, 1958).

Lepus callotis and *L. flavigularis* both inhabit the state of

Oaxaca, *L. callotis* in the high zones of central Oaxaca and *L. flavigularis* in the lowlands near the coast. They are separated in the Isthmus of Tehuantepec by an altitudinal gradient (Uribe-Alcocer et al., 1983).

Mammals occurring with *L. callotis* include *Thomomys bottae*, *Perognathus flavus*, *Dipodomys ordii*, *Reithrodontomys fulvescens*, *R. megalotis*, *Peromyscus boylii*, *P. maniculatus*, *P. truei*, *Baiomys taylori*, *Sigmodon minimus*, *S. ochrognathus*, *Neotoma mexicana*, *Rattus rattus*, *Mus musculus*, *L. californicus*, *Sylvilagus audubonii*, *S. floridanus*, *Spermophilus variegatus* (Anderson and Long, 1961), *S. mexicanus*, *S. spilosoma*, *Notiosorex crawfordi*, *Cynomys ludovicianus*, *C. mexicanus*, *Cratogeomys castanops*, *Chaetodipus hispidus*, *C. penicillatus*, *Dipodomys spectabilis*, *D. nelsoni*, *Liomys irroratus*, *Reithrodontomys montanus*, *Onychomys leucogaster* (including *O. arenicola*), *Sigmodon hispidus*, *Neotoma micropus*, *Canis latrans*, *Vulpes macrotis*, *Mustela frenata*, *Taxidea taxus*, *Mephitis mephitis*, *M. macroura*, *Conepatus mesoleucus*, *Lynx rufus*, *Antilocapra americana*, *Bison bison* (Packard, 1977), and *Ovis canadensis* (Goldman and Moore, 1946). Mammalian predators may include *Canis latrans* and *Vulpes macrotis*. Avian predators may include golden eagle (*Aquila chrysaetos*), marsh hawk (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*B. swainsoni*), and great horned owl (*Bubo virginianus*—J. C. Bednarz, in litt.). In Chihuahua, white-sided jackrabbits are used as food by humans (Bogan and Jones, 1975). In Zacatecas, local residents consider this species highly edible (Matson and Baker, 1986).

Microorganisms isolated from *L. callotis* include *Staphylococcus aureus*, *Pneumococcus*, *Streptococcus*, *Bacillus*, *Pseudomonas pseudomallei*, *Alcaligenes denitrificans*, *Enterobacter agglomerans*, *Klebsiella ozanae*, *Escherichia coli*, a *Moraxella*-like organism, *Yersinia pseudotuberculosis*, and a coccidian (J. C. Bednarz, in litt.; Dunn et al., 1982). Ectoparasites include the flea *Pulex simulans* and the tick *Dermacentor paramapertus* (Dunn et al., 1982).

The white-sided jackrabbit has been reported as rare throughout its range (Dalquest, 1953; Davis and Russell, 1953; Findley and Caire, 1977), and has been proposed for listing as a threatened or endangered species (Baker, 1977; Dunlop, 1989)—it is listed as threatened and endangered in New Mexico (New Mexico Department of Game and Fish, in litt.). This species commonly comes into contact with agriculture (Chapman et al., 1983). Livestock grazing may be one of the factors contributing to the decline of *L. callotis* and apparent replacement by the highly adaptable *L. californicus* (Baker, 1977). Prospects for the survival of this species in many parts of its range are poor (Matson and Baker, 1986).

BEHAVIOR. In New Mexico, most activity of *L. callotis* occurs from 2200 to 0500 h (Dunn et al., 1982), particularly on clear nights with bright moonlight. Cloud cover, precipitation, and wind limit the amount of activity, whereas temperature may have little effect (J. C. Bednarz, in litt.). In Zacatecas, this species usually was seen in early morning or at dusk, often at edges of oak-woodlands in foothills; one was flushed from under an oak tree (Matson and Baker, 1986).

In New Mexico, white-sided jackrabbits were flushed only in tabosagrass, and appeared to flee to other tabosagrass stands (Findley et al., 1975). The escape behavior is similar to that of *L. alleni*. When flushed, *L. callotis* alternately flashes its white sides while running away from the intruder (Fig. 5). Another escape behavior is that of leaping straight upward while extending the hind legs and flashing the white sides. This behavior is seen when the white-sided jackrabbit is startled or alarmed by a predator (Dunn et al., 1982).

The most conspicuous trait of *L. callotis* is its tendency to occur in pairs. These pairs consist of a male and female that appear to exhibit a pair bond that is most evident during the breeding season. Once the pair bond is established the male defends the pair from intruding males. Pair bonding may serve to keep the sexes together during the breeding season, since densities are low (Dunn et al., 1982). In New Mexico, *L. callotis* almost always is observed in pairs (Conway, 1976). The members of the pair remain within 5 m of one another. Pairs flushed in front of observers at distances of 5–25 m and ran together for distances up to 0.5 km (Bogan and Jones, 1975). During summer in Zacatecas, *L. callotis* almost always is observed in pairs (Matson and Baker, 1986). In Chihuahua, this species was seen in pairs each month from May through October (Anderson, 1972). The pair bond may not be broken by pregnancy,



FIG. 5. *Lepus callotis* in alert posture (left) and running (right). Note the conspicuous white sides that are displayed here compared with the camouflage of the resting position shown in Fig. 1. Photographs courtesy of C. G. Schmitt and M. C. Conway, New Mexico Department of Game and Fish.

as one pair collected in New Mexico on 12 March consisted of a male and a female with a near-term fetus (Cook, 1986).

The white-sided jackrabbit constructs and utilizes shelter forms (Fig. 6). These shelter forms are slightly larger than those reported for *L. californicus*, averaging 37 cm in length, 18.3 cm in width, and 6.3 cm in depth. Dense stands of tabosagrass usually surround the shelter form, which is located in clumps of grass. *L. callotis* may occupy underground shelters, although such behavior is rare. One was flushed from an abandoned den of *Vulpes macrotis* (Dunn et al., 1982), and a young white-sided jackrabbit took refuge in a burrow as it escaped from a caracara (*Caracara cheriway*). The circumstance suggested the young animal had been born in the burrow (Vorhies and Taylor, 1933).

Lepus callotis usually forages by chewing and pulling grass blades near the ground until they break off or are uprooted. The hare then raises its head, and while sitting in a crouched position, slowly ingests by chewing the piece of grass sticking out of the mouth. Blades of grass that are dropped to the ground are not retrieved. Forepaws seldom are used for anything other than bracing against the ground as grass is bitten off or uprooted. However, it uses its forepaws to excavate the bulbous tubers of young nutgrass (*Cyperus rotundus*). Foraging depressions made in this way are oval and average 12 cm long, 9 cm wide, and 2 cm deep. Maximum and minimum sizes are 19 by 15 by 3 cm and 7 by 5 by 1 cm, respectively. Fecal pellets often are found areas where several foraging depressions occur (J. C. Bednarz, in litt.).

Three types of vocalizations have been heard. One, an alarm or fear reaction, was a high-pitched scream. The second occurred when an intruding male approached a pair of white-sided jackrabbits. The male of the pair emitted harsh grunts until the intruder left or was chased away. The third type of vocalization occurred during a sexual chase and consisted of a trilling grunt. It was not determined which member of the pair produced this sound (Dunn et al., 1982).

GENETICS. The karyotype of *L. callotis* is not known. However, this species and *L. flavigularis* probably share the diploid number of 48 chromosomes and the same fundamental number of 88 chromosomal arms (Uribe-Alcocer et al., 1989).

REMARKS. A numerical taxonomic analysis of 12 cranial characters of *L. callotis*, *L. californicus*, and *L. flavigularis* showed only partial separation of *L. callotis* and *L. californicus* in cluster analysis. However, there was nearly complete separation between the clusters of these two species and *L. flavigularis*. This analysis supports the specific taxonomic rank of *L. flavigularis*, but leaves open to question the relationship between *L. callotis* and the Mexican subspecies of *L. californicus* (Dixon et al., 1983). Shamel (1942) regarded the eastern subspecies of *L. californicus* as more closely related to *L. callotis*, but Hall (1951) considered them to be subspecies of *L. californicus*. *L. flavigularis* is more like *L. callotis*



FIG. 6. Shelter form of *Lepus callotis* near Cloverdale, Hidalgo Co., New Mexico. Photograph courtesy of C. G. Schmitt and M. C. Conway, New Mexico Department of Game and Fish.

than either of these two species is like *L. alleni* (Anderson and Gaunt, 1962; Hall, 1981).

The name *Lepus callotis* was used for a time in the 1800s to refer to specimens now representing several subspecies of *L. californicus*. *L. callotis* has been used by most authors since 1830 to refer to the white-sided jackrabbit. However, Hall and Kelson (1959) used *L. mexicanus* because of supposed priority, but the priority of *L. mexicanus* cannot be documented (Anderson and Gaunt, 1962).

The Latin word *Lepus* means hare (Jaeger, 1955). The name *callotis* is derived from the Greek words *call* referring to beautiful and *ot* referring to ear. The common names of beautiful-eared jack rabbit (Elliot, 1905), Gaillard jack rabbit (Nelson, 1909), and snow sides (Bogan and Jones, 1975) also have been used to refer to this species.

We thank T. D. Henry for assistance in locating literature, L. L. Thornton and other personnel in the Interlibrary Loan Department at Auburn University R. B. Draughon Library for assistance in obtaining articles from other institutions, and K. A. Howard for preparing Fig. 3. C. G. Schmitt generously provided assistance in obtaining photographs. G. W. Folkerts, C. Guyer, R. S. Lishak, E. C. Oaks, and an anonymous reviewer critically evaluated an early draft of the manuscript. This is journal article no. 15-913139 of the Alabama Agricultural Experiment Station.

LITERATURE CITED

- ALLEN, J. A. 1904. Further notes on mammals from northwestern Durango. *Bulletin of the American Museum of Natural History*, 20:205-210.
- . 1906. Mammals from the states of Sinaloa and Jalisco, Mexico, collected by J. H. Batty during 1904 and 1905. *Bulletin of the American Museum of Natural History*, 22:191-262.
- ANDERSON, S. 1972. Mammals of Chihuahua: taxonomy and distribution. *Bulletin of the American Museum of Natural History*, 148:149-410.
- ANDERSON, S., AND A. S. GAUNT. 1962. A classification of the white-sided jack rabbits of Mexico. *American Museum Novitates*, 2088:1-16.
- ANDERSON, S., AND C. A. LONG. 1961. Small mammals in pellets of barn owls from Miñaca, Chihuahua. *American Museum Novitates*, 2052:1-3.
- BAILEY, V. 1931. Mammals of New Mexico. *North American Fauna*, 53:1-412.
- BAKER, R. H. 1960. Mammals of the Guadiana lava field, Durango, Mexico. *Publications of the Museum, Michigan State University, Biological Series*, 1:303-327.
- . 1977. Mammals of the Chihuahuan Desert region—future prospects. Pp. 221-225, in *Transactions of the symposium on the biological resources of the Chihuahuan Desert region United States and Mexico* (R. H. Wauer and D. H. Riskind, eds.). United States Department of the Interior, National Park Service Transactions and Proceedings Series, 3: 1-658.

- BAKER, R. H., AND J. K. GREER. 1962. Mammals of the Mexican state of Durango. Publications of the Museum, Michigan State University, Biological Series, 2:25-154.
- BEDNARZ, J. C., AND J. A. COOK. 1984. Distribution and numbers of the white-sided jackrabbit (*Lepus callotis gaillardii*) in New Mexico. The Southwestern Naturalist, 29:358-360.
- BENNETT [no initials]. 1833. [no title] Proceedings of the Zoological Society of London, 1833:39-42.
- BOGAN, M. A., AND C. JONES. 1975. Observations on *Lepus callotis* in New Mexico. Proceedings of the Biological Society of Washington, 88:45-49.
- CHAPMAN, J. A., K. R. DIXON, W. LOPEZ-FORMENT, AND D. E. WILSON. 1983. The New World jackrabbits and hares (genus *Lepus*).—1. Taxonomic history and population status. Acta Zoologica Fennica, 174:49-51.
- CONWAY, M. C. 1976. A rare hare. New Mexico Wildlife, 21(2): 21-23.
- COOK, J. A. 1986. The mammals of the Animas Mountains and adjacent areas, Hidalgo County, New Mexico. Occasional Papers, The Museum of Southwestern Biology, 4:1-45.
- DALQUEST, W. W. 1953. Mammals of the Mexican state of San Luis Potosí. Louisiana State University Press, Baton Rouge, 229 pp.
- DAVIS, W. B., AND P. W. LUKENS, JR. 1958. Mammals of the Mexican state of Guerrero, exclusive of Chiroptera and Rodentia. Journal of Mammalogy, 39:347-367.
- DAVIS, W. B., AND R. J. RUSSELL. 1953. Aves y mamíferos del estado de Morelos. Revista de la Sociedad Mexicana de Historia Natural, 14:77-147.
- DAWSON, M. R. 1967. Lagomorph history and the stratigraphic record. Pp. 287-316, in Essays in paleontology and stratigraphy: R. C. Moore commemorative volume. Department of Geology, University of Kansas, Special Publication, 2:1-626.
- DIXON, K. R., J. A. CHAPMAN, G. R. WILLNER, D. E. WILSON, AND W. LOPEZ-FORMENT. 1983. The New World jackrabbits and hares (genus *Lepus*).—2. Numerical taxonomic analysis. Acta Zoologica Fennica, 174:53-56.
- DUNLOP, B. N. 1989. Endangered and threatened wildlife and plants; animal notice of review. Federal Register, 54:554-579.
- DUNN, J. P., J. A. CHAPMAN, AND R. E. MARSH. 1982. Jackrabbits: *Lepus californicus* and allies. Pp. 124-145, in Wild mammals of North America: biology, management, and economics (J. A. Chapman and G. A. Feldhamer, eds.). The Johns Hopkins University Press, Baltimore, 1147 pp.
- ELLIOT, D. G. 1905. A check list of mammals of the North American continent the West Indies and the neighboring seas. Field Columbian Museum Publication 105, Zoological Series, 6:1-701.
- FINDLEY, J. S. 1987. The natural history of New Mexican mammals. University of New Mexico Press, Albuquerque, 164 pp.
- FINDLEY, J. S., AND W. CAIRE. 1977. The status of mammals in the northern region of the Chihuahuan Desert. Pp. 127-139, in Transactions of the symposium on the biological resources of the Chihuahuan Desert region United States and Mexico (R. H. Wauer and D. H. Riskind, eds.). United States Department of the Interior, National Park Service Transactions and Proceedings Series, 3:1-658.
- FINDLEY, J. S., A. H. HARRIS, D. E. WILSON, AND C. JONES. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, 360 pp.
- GOLDMAN, E. A. 1951. Biological investigations in México. Smithsonian Miscellaneous Collections, 115:1-476.
- GOLDMAN, E. A., AND R. T. MOORE. 1946. The biotic provinces of Mexico. Journal of Mammalogy, 26:347-360.
- HALL, E. R. 1951. A synopsis of the North American Lagomorpha. University of Kansas Publications, Museum of Natural History, 5:119-202.
- . 1981. The mammals of North America. Second ed. John Wiley & Sons, New York, 1:1-600 + 90.
- HALL, E. R., AND K. R. KELSON. 1959. The mammals of North America. The Ronald Press Company, New York, 1:1-546 + 79.
- HARRIS, A. H. 1977. Wisconsin age environments in the northern Chihuahuan Desert: evidence from the higher vertebrates. Pp. 23-52, in Transactions of the symposium on the biological resources of the Chihuahuan Desert region United States and Mexico (R. H. Wauer and D. H. Riskind, eds.). United States Department of the Interior, National Park Service Transactions and Proceedings Series, 3:1-658.
- HOFFMEISTER, D. F. 1986. Mammals of Arizona. The University of Arizona Press and The Arizona Game and Fish Department [Tucson], 602 pp.
- HOFFMEISTER, D. F., AND W. W. GOODPASTER. 1954. The mammals of the Huachuca Mountains, southeastern Arizona. Illinois Biological Monographs, 24:1-152.
- HONACKI, J. H., K. E. KINMAN, AND J. W. KOEPL (EDS.). 1982. Mammal species of the world: a taxonomic and geographic reference. Allen Press, Inc., and The Association of Systematics Collections, Lawrence, Kansas, 694 pp.
- JAEGER, E. C. 1955. A source-book of biological names and terms. Third ed. Charles C Thomas Publisher, Springfield, Illinois, 323 pp.
- LICHTENSTEIN, M. H. C. 1830. Erläuterungen der Nachrichten des Franc. Hernandez von den vierfüßigen Thieren Neuspaniens. Abhandl. K. Akad. Wiss., Berlin, for 1827, pp. 89-123 (not seen, cited in Anderson and Gaunt, 1962).
- MATSON, J. O., AND R. H. BAKER. 1986. Mammals of Zacatecas. Special Publications, The Museum, Texas Tech University, 24: 1-88.
- MEARNS, E. A. 1895. Preliminary description of a new subgenus and six new species and subspecies of hares, from the Mexican border of the United States. Proceedings of the United States National Museum, 18:551-565.
- NELSON, E. W. 1909. The rabbits of North America. North American Fauna, 29:1-314.
- NOWAK, R. M., AND J. L. PARADISO. 1983. Walker's mammals of the world. Fourth ed. The Johns Hopkins University Press, Baltimore, 1:1-568.
- PACKARD, R. L. 1977. Mammals of the southern Chihuahuan Desert: an inventory. Pp. 141-153, in Transactions of the symposium on the biological resources of the Chihuahuan Desert region United States and Mexico (R. H. Wauer and D. H. Riskind, eds.). United States Department of the Interior, National Park Service Transactions and Proceedings Series, 3: 1-658.
- PETERSEN, M. K. 1976. The Rio Nazas as a factor in mammalian distribution in Durango, Mexico. The Southwestern Naturalist, 20:495-502.
- SCHMIDLY, D. J. 1977. Factors governing the distribution of mammals in the Chihuahuan Desert region. Pp. 163-192, in Transactions of the symposium on the biological resources of the Chihuahuan Desert region United States and Mexico (R. H. Wauer and D. H. Riskind, eds.). United States Department of the Interior, National Park Service Transactions and Proceedings Series, 3:1-658.
- SCHULTZ, C. B., AND E. B. HOWARD. 1935. The fauna of Burnet Cave, Guadalupe Mountains, New Mexico. Proceedings of the Academy of Natural Sciences of Philadelphia, 87:273-298.
- SHAMEL, H. H. 1942. The subgeneric status of the *Lepus californicus* group of hares. Proceedings of the Biological Society of Washington, 55:25.
- URIBE-ALCOCER, M., L. GUERANA-GANDARA, AND F. CERVANTES-REZA. 1983. The karyotype of the tropical hare (*Lepus flavigularis*). Mammalian Chromosome Newsletter, 24:103-111.
- URIBE-ALCOCER, M., F. A. CERVANTES, C. LORENZO-MONTEERRUBIO, AND L. GUERANA-GANDARA. 1989. Karyotype of the tropical hare (*Lepus flavigularis*, Leporidae). The Southwestern Naturalist, 34:304-306.
- VORHIES, C. T., AND W. P. TAYLOR. 1933. The life histories and ecology of jack rabbits, *Lepus alleni* and *Lepus californicus* ssp., in relation to grazing in Arizona. University of Arizona, College of Agriculture, Agricultural Experiment Station Technical Bulletin, 49:471-587.
- WAGLER, J. 1830. Natürliches system der amphibien, mit vorangehender classification der säugthiere und vögel. J. G. Cottaehen Buchhandlung, Munich, Germany. 354 pp.

Editors of this account were J. ALDEN LACKEY and KARL F. KOOPMAN. Managing editor was CRAIG S. HOOD.

T. L. BEST AND T. H. HENRY, DEPARTMENT OF ZOOLOGY AND WILDLIFE SCIENCE AND ALABAMA AGRICULTURAL EXPERIMENT STATION, 331 FUNCHESSE HALL, AUBURN UNIVERSITY, ALABAMA 36849-5414.